REMARKS

Favorable reconsideration is respectfully requested in view of the above amendments and following remarks. Claims 6, 8 and 18-21 have been amended. The amendment to claim 6 is supported by the original disclosure, for example, at page 8, lines 9-11 and Example 10. Claims 6, 8 and 18-21 have been amended editorially. No new matter has been added. Claims 6-8, 11 and 18-21 are pending.

Claim Rejections – 35 USC §112

Claim 6-8, 11 and 18-21 are rejected under 35 USC 112, second paragraph, as being indefinite. Claim 6 recites administering. The antecedent basis has been corrected for claim 8. Claim 6 recites administering, to living plants or seeds of the living plants. Claim 8 recites the method as claimed in claim 6, wherein the effective amount is from 0.1 g to 100 g per liter, and wherein the administering is in liquid form via the leaves, in nutritive solution for roots or in solution for seed. Thus, claim 8 is consistent with the scope of claim 6 as to seeds. Regarding post-harvest treatment, Applicants respectfully submit that post-harvest plants are considered living plants. That is, as described in Yang et al., "Induced Resistance in Melons by Elicitors for the Control of Postharvest Diseases", Postharvest Pathology, Plant Pathology in the 21st Centry, Vol. 2, pp. 31-41, plants can be infected by pathogens and develop postharvest diseases. Such diseases can be prevented by providing induced resistance by elicitors to postharvest plants, which absorbs the elicitors and develops resistance to ward off diseases. As such, in the field of plant science, postharvest plants are considered to be living for a certain period of time after it has been separated from the roots. Thus, claim 8 is consistent with the scope of claim 6 as to post-harvest treatment. Claim 18 recites wherein the effective amount is 1 g per liter. Claim 19 recites wherein the effective amount is from 10 to 1000 g per hectare, and wherein the administering is in the form of a solid, pulverulent or granulated products. Claim 20 recites wherein the effective amount is 200 g per hectare. Claim 21 recites administering. Therefore, claims 6-8, 11 and 18-21 are definite.

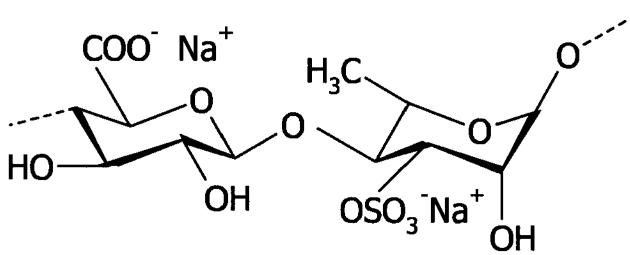
Withdrawal of the rejection is respectfully requested.

Claim Rejections – 35 USC §102

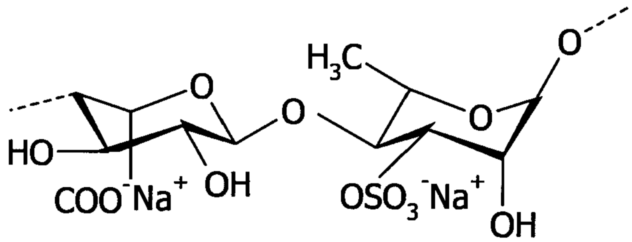
Claims 6-8 and 18-21 are rejected under 35 USC 102(b) as being anticipated by US 2004/0023924 or FR 2814471 (Lienart). Applicants respectfully traverse the rejection.

Lienart is directed to new uses of xyloglucan polymers or oligomers (paragraph [0001]). The reference teaches that xyloglucan is a 1,4-β-glucan polymer substituted with 1,6 α-D-xylose or 1,6 α-D-xylose- 1,2 β-D-galactosyl-type branchings, where fucose can be associated at the terminal position with the galactose (paragraph [0003]). The reference in particular teaches xyloglucan having the formula X_1-X_2-X_3-$(X_4)_n$, where X_1 represents fucose, X_2 represents galactose, X_3 represents xylose or glucose and X_4 represents glucose, optionally substituted by a sugar such as glucose, each of X_1, X_2, X_3 and X_4 being (L) or (D) glycosyl residues in α or β form, and n represents 0 or 1 (paragraph [0048]). Lienart provides a specific example of xyloglucan isolated from *Ulva lactuca* having the formula β-D-xylose (1→4) β-D-glucose (1→4) β-D-glucose (paragraph [0063]).

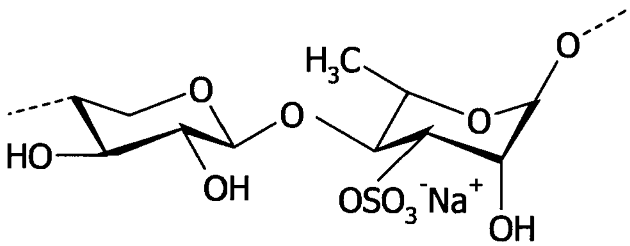
On the other hand, claim 6 recites administering, to living plants or seeds of the living plants, an effective amount of (1) ulvans extracted from green algae of the genus *Ulva* or *Enteromorpha*, or (2) a reaction product obtained from hydrolysis or enzymatic hydrolysis of the ulvans of (1). Ulvans are highly sulfated acidic polysaccharides and are essentially composed of units derived from rhamnose 3-sulfate, xylose, xylose 2-sulfate, glucuronic acid and iduronic acid (see page 4, lines 17-21 of the specification). Examples of ulvans are provided as below:



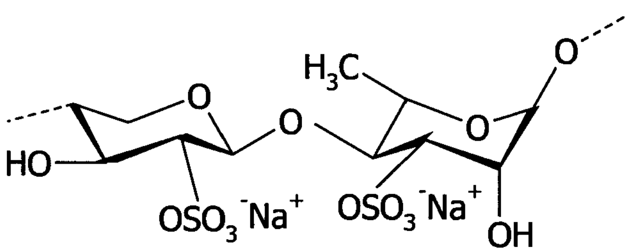
>4)- β-D-GlcA- (1>4)- α-L-Rha 3 sulfate(1>
(also called ulvanobiouronic acid 3-sulfate type A)



>4)- α-L-IdoA- (1>4)- α-L-Rha 3 sulfate(1>
(also called ulvanobiuronic acid 3-sulfate type B)



>4)- β-D-Xyl- (1>4)- α-L-Rha 3 sulfate(1>
(also called ulvanobiose acid 3-sulfate)



>4)- β-D-Xyl 2 -sulfate- (1>4)- α-L-Rha 3 sulfate(1>
(also called ulvanobiose acid 2',3-disulfate) (see page 4, line 21 to page 5, line 14 of the specification).

The rejection appears to refer to paragraph [0101] of Lienart and contends that Lienart teaches (1) ulvans extracted from green algae of the genus *Ulva* or *Enteromorpha*, or (2) a reaction product obtained from hydrolysis or enzymatic hydrolysis of the ulvans of (1) as recited in claim 6. However, Lienart clearly indicates in paragraph [0087] that what they obtain from *Ulva lactuca* or *Ulva rigida* is xyloglucan polymers or oligomers. As is clear from the above, the xyloglucan polymer or oligomers do not correspond to the (1) ulvans

extracted from green algae of the genus *Ulva* or *Enteromorpha*, or (2) a reaction product obtained from hydrolysis or enzymatic hydrolysis of the ulvans of (1) as recited in claim 6. Nothing in the reference teaches or suggests the use of (1) ulvans extracted from green algae of the genus *Ulva* or *Enteromorpha*, or (2) a reaction product obtained from hydrolysis or enzymatic hydrolysis of the ulvans of (1), as required by claim 6. Accordingly, claim 6 and its dependent claims are patentable over the reference.

Claim Rejections – 35 USC §103

Claims 6-8, 11 and 18-21 are rejected under 35 USC 103(a) as being unpatentable over US 2004/0023924 or FR 2814471 (Lienart) in view of US 6,837,002 (Costa). Applicants respectfully traverse the rejection.

Claim 6 has been distinguished above over Lienart. Claims 7-8, 11 and 18-21 depend from claim 6 and are patentable over the reference for at least the same reasons as claim 6. Applicants do not concede the correctness of the rejection.

In view of the above, favorable reconsideration in the form of a notice of allowance is requested. Any questions or concerns regarding this communication can be directed to the attorney-of-record, Douglas P. Mueller, Reg. No. 30,300, at (612) 455.3804.

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PATENT TRADEMARK OFFICE

Dated: March 5, 2010

Respectfully submitted,

HAMRE, SCHUMANN, MUELLER & LARSON, P.C.
P.O. Box 2902
Minneapolis, MN 55402-0902
(612) 455-3800

By: [signature]
Douglas P. Mueller
Reg. No. 30,300

Chapter 3
Induced Resistance in Melons by Elicitors for the Control of Postharvest Diseases

Bi Yang, Li Yongcai, Ge Yonghong, and Wang Yi

Abstract Melons fruit can be induced to develop enhanced resistance to pathogen infection by pre- or postharvest treatment with a variety of chemical, physical and biological elicitors. The elicitors include acibenzolar, soluble silicon, oxalic acid, chitosan, β-aminobutyric acid, 2,6-dichloroisonicotinic acid, heat treatment and harpin. Resistance induced is broad spectrum and long lasting, but rarely provides complete control of infection. The mechanism of induced resistance is involved in the accumulation of defense enzymes, antifungal compounds, increasing of reactive oxygen species and lignification of epidermal cells. In order to maximize the efficacy of resistance elicitors, it is required to understand of the mechanism of induced resistance and the effect factors of pre- or postharvest. There also needs to evaluate quality change in induced fruit. It is concluded that control of melons postharvest disease by induced resistance would be the use of integrated approach combining chemical, physical and biological control methods, and culture practices.

Keywords postharvest diseases • induced resistance • fruit • elicitors

3.1 Introduction

Melons, *Cucumis melo* L., are well known members of the *Cucurbitaceae* family, has been divided into a number of botanical subspecies (Sykes 1990). The major ones are cantaloupes (*Cucumis melo* var. *cantalupensis*), muskmelons (*C. melo* var. *reticulatus*), oriental melons (*C. melo* var. *chinensis*) and winter melons (*C. melo* var. *inodorus*). China is the biggest producer of melons in the world (Bi et al. 2007b).

Bi Y.,(✉), Li Y.C., Ge Y.H., and Wang Y.
College of Food Science and Engineering, Gansu Agricultural University,
Lanzhou, 730070, China
e-mail: beyang62@163.com

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The melons are quite perishable after harvest. A various types of pathogens are involved in fruit decay (Snowdon 1990; Barkai-Golan 2001). In China, melons are infected by Alternaria rot (*Alternaria alternata*), blue mold rot (*Penicillium spp.*), Fusarium rot (*Fusarium spp.*), Green mold rot (*Cladosporium sp.*), Mucor rot (*Mucor mucedo*), pink mold rot (*Trichothecium roseum*), Rhizopus rot (*Rhizopus spp.*), sour rot (*Geotrichum candidum*) (Bi et al. 2003). Both *Alternaria* and *Fusarium* rots are related to latent infection (Ge et al. 2005b). Postharvest losses are estimated to be as 35–50% because of rough handling after harvest, inadequate packaging and temperature management (Bi et al. 2007b).

Postharvest disease of melons is often controlled by the application of synthetic fungicides, such as benomyl and guazatine (Morris and Wade 1983), imazalil (Aharoni et al. 1992), iprodione and azoxystrobin (Ma et al. 2004). However, due to problems related to fungicide residues, development of fungicide resistance by pathogens, and potential harmful effects on the environment, as well as the necessity to reduce losses with minimal use of fungicides, new strategies for controlling postharvest diseases have been proposed (Wilson et al. 1994).

Induced resistance is a natural defense response triggered by pathogen or elicitors (Kuc 2001). Induced resistance includes local induced resistance and systemic acquired resistance (SAR). The former is directly producing disease resistance at the guided position; the latter is that untreated part produced disease resistance after treated the other part (Ryals et al. 1996). Induction disease resistance in harvested horticultural crops using physical, biological and chemical elicitors has received increasing attention over recent years, it being considered a preferred strategy for disease management (Terry and Joyce 2004). Fruit and vegetables can be induced to develop enhanced resistance to pathogen infection by pre- or postharvest treatment with a variety of chemical elicitors (Bi et al. 2007c). In this chapter, we provide a description of research that indicates that induced resistance by elicitors can be part of postharvest disease control, and provide a brief knowledge on the mechanism of induced resistance in melons.

3.2 Chemically Induced Resistance

3.2.1 Acibenzolar

Acibenzolar (benzo-(1, 2, 3)-thiadiazole-7-carbo-thioicacidS-methylester; ASM; BTH; Bion™; Actigard™) is perhaps the most potent synthetic SAR activator discovered to date (Terry and Joyce 2004; Kessmann et al. 1994; Friedrich et al. 1996). The chemical is not phytotoxic and has proven an effective SAR elicitor in both monocotyledons (Gorlach et al. 1996) and dicotyledons (Tally et al. 2000). In recent years, ASM has been extensively studied to control postharvest diseases in apple (Spadaro et al. 2004), pear (Cao and Jiang 2006), peach (Liu et al. 2005), strawberry (Terry and Joyce 2000), passionfruit (Willingham et al. 2002), mango (Dann and Zainunuri 2008) and potato (Bokshi et al. 2003).

Huang et al. (2000) found a pre-flowering foliar spray of ASM at 50 mg/L combined with a fruit dip in guazatine at 500 mg/L at harvest substantially decreased disease in stored rockmelons and Hami melons. Preharvest treatment with ASM at 50 mg/L four times from anthesis and one time (3 weeks before harvest) also reduced Alternaria and Fusarium rots in harvested rockmelons (Bokshi et al. 2006). A foliar spraying with ASM at 100 mg/L 1 week or 1 day before harvest decreased the lesion area of harvested muskmelons inoculated with *F. semitectum* and *T. roseum* (Ge et al. 2008). Field spraying with ASM at 100 mg/L significantly reduced the latent infection rate of muskmelons. Four sprays from anthesis reduced latent infection rate in fruit caused by *A. alternata* and *Fusarium* spp, by 66.7 and 60% (Zhang et al. 2006b). Postharvest treatment with ASM at 200 mg/L noticeably reduced decay severity caused by *A. alternata, F. semitectum* and *T. roseum* in Hami melon (Bi et al. 2006). Postharvest ASM treatment at 100 mg/L suppressed lesion diameter in treated and untreated halves of the same fruit inoculated with *T. roseum*, indicating that the chemical induced local and systemic resistance (Wang et al. 2008).

As a functional analogue of SA, ASM acts downstream of SA and elicits accumulation of the same SAR genes and pathogenesis-related proteins (PRs) as SA (Friedrich et al. 1996). Bi et al. (2006b) reported that activity of peroxidase (POD), chitinase (CHT) and phenylalanine ammonia lyase (PAL) was significantly enhanced in harvested Hami melons treated with ASM. Similar results were also observed in rockmelons (Bokshi et al. 2006) and muskmelons (Wang et al. 2008). ASM treatment increased production of reactive oxygen species, augmented the content of the preformed antifungal compounds, total phenolics and lignin, and accumulated lignin, suberin and callose in muskmelon (Bi et al., unpublished data).

3.2.2 Silicon

Silicon (Si) is the second most abundant element in the lithosphere (27.70%) and it is as important as phosphorus and magnesium (0.03%) in the biota (Exley 1998). Si is also considered to be biologically active and to trigger a faster and more extensive deployment of plant natural defenses (Fauteux et al. 2005). Si has been shown to reduce postharvest diseases in pear (Spotts and Cervantes 1989), cherry (Qin and Tian 2005) and jujube (Tian et al. 2005).

Postharvest application of silicon oxide and sodium silicate tended to suppress postharvest pink rot severity caused by *T. roseum* in muskmelons (Guo et al. 2007). Sodium silicate at 100 mM significantly reduced decay incidence and severity of Hami melons inoculated with *A. alternata, F. semitectum*, and *T. roseum*. Si treatments at 100 mM were also effective in reducing natural infections of Hami melons. Si treatments applied at 100 mM pre-inoculation with *T. roseum* had lower decay incidence and severity than treatments applied post-inoculation, indicated resistance induction of occurred in melon fruit (Bi et al. 2006a).

Postharvest treatment with Si proved effective for inhibiting pathogen growth as well as inducing disease resistance in melons. Sodium silicate has been shown to have direct inhibition *in vitro* antifungal activity against postharvest pathogens of

melons (Bi et al. 2006a). Si treatment resulted in enhanced activity of POD and PAL (Guo et al. 2007). Si also caused a more progressive and significant increase in POD and CHT activities in Hami melons challenged by *T. roseum* (Bi et al. 2006a). Si treatment enhanced the production of reactive oxygen species and maintained fruit firmness. The accumulation of antifungal compounds was observed in Si treated muskmelons (Bi et al., unpublished data).

3.2.3 Other Chemicals

The application of oxalic acid has already been shown to induce systemic resistance against field diseases in cucumber (Mucharroman and Kuc 1991). The chemical has been confirmed to reduce postharvest diseases in mango (Zheng et al. 2007) and longan (Whangchai et al. 2006). Postharvest oxalic acid dipping at 50 mM reduced significantly decay severity of muskmelon fruit inoculated with *T. roseum*. A systemic resistance was observed in untreated halves of the same fruit (Deng et al. 2008).

Chitosan has been considered a promising means for enhancing disease resistance in harvested horticultural commodities (Wilson et al. 1994; El Ghaouth 1994). A significant reduction of rots has been recorded in chitosan-treated apple (Bautista-Banos et al. 2004), pear and kiwifruit (Du et al. 1997), table grape (Meng et al. 2008), strawberries (Zhang and Quantick 1998), bell pepper (El Ghaouth et al. 1997), tomato (Liu et al. 2007), carrots (Cheah et al. 1997). Preharvest treatment with chitosan at 1 mg/mL significantly reduced the latent infection rate of muskmelons. Three and four sprays from anthesis significantly reduced latent infection rate in fruit caused by *A. alternata* and *Fusarium* spp. Four sprays before harvest also decreased the lesion area of harvested muskmelons inoculated with *A. alternata, F. semitectum* and *T. roseum,* indicated resistance induced in melon fruit (Xie et al. 2008).

Although β-aminobutyric acid (BABA) is only rarely found naturally in plants, it has proved to be a potent inducer of acquired resistance and has a broad spectrum of activity against many disease-causing organisms (Cohen 2002; Jakab et al. 2001). Earlier foliage application of BABA at 2000 mg/L reduced the total storage rots, Alternaria and Fusarium rots of fruit. The chemical caused activation of CHT and POD activities in treated leaves of rockmelons (Bokshi et al. 2006).

2,6-dichloroisonicotinic acid (INA) protect many crops against their pathogens. INA is weakly fungistatic *in vitro*, but effectively elicits SAR genes in tobacco prior to TMV challenge inoculation (Ward et al. 1991). The INA-mediated resistance has been reported to be against a broad spectrum of pathogens (Uknes et al. 1992) and the induced resistance has been suggested to have a long-lasting effect (Lucas 1999). Bokshi et al. (2006) found that earlier foliage application of INA at 50 mg/L significantly reduces the postharvest diseases of rockmelons. Activity of CHT and POD in treated leaves were stimulated and maintained at a higher level three days after a first spray with INA rather than BABA, and second spray of INA increased CHT and POD activities further and the increase lasted several weeks until harvest.

3.3 Physically Induced Resistance

Heat treatment is considered a promising method for reducing postharvest disease (Lurie 1998). It may be effective either by directly inhibiting pathogen development, or by inducing natural resistance in the fruit (Klein and Lurie 1991; Schirra et al. 2000). Induction of resistance against decay due to hot water treatment of muskmelons for 3 min at 55°C before inoculation was reported by Zhang et al. (2005). The resistance was found to be most effective when inoculation was carried out 24 h after hot water treatment. Dipping melons in hot water not only reduced pathogens causing storage disease but also significantly improved the life and marketability of fruit (Fallik et al. 2000). Teitel et al. (1989) found that with a longer immersion time, a hot water dip may have provided effective protection for melon fruit against storage rots. They observed that a reduced temperature of 52°C and a longer dip time of 2 min controlled decay from *Alternaria* spp., *Fusarium spp.*, *Rhizopus* spp. and *Mucor* spp. without causing external heat injury. Similar observation made by Mayberry and Hartz (1992), and Barkai-Golan et al. (1994), who reported that hot water treatment of 'Galia' melon at 52–55°C effectively prevented storage losses caused by *A. alternata, Fusarium spp.* and *T. roseum.* A mixture of fungicides and hot water could result in an effective decay control of melons. Zhang et al. (2005) observed that hot water treatment at 55°C for 1 min combined with 50 mg/ L azoxystrobin or 250 mg/L imazalil significantly controlled the rots of muskmelons caused by *R. stolonifer, Fusarium* spp. *and T. roseum.*

3.4 Biologically Induced Resistance

Harpin (Messenge™) is an acidic, heat-stable, glycine-rich, 44-kDa protein, encoded by the *hrpN* gene of the bacterium *Erwinia amylovora* (Wei et al. 1992). It is the first known bacterial product able to elicit the hypersensitive response (HR) and to induce systemic acquired resistance in plants (Baker et al. 1993; Dong et al. 1999; Mullin et al. 1998). Postharvest treatment with harpin has been shown to induce resistance in apple (de Capdeville et al. 2003) and pear (Wang et al. 2006).

Field spraying with harpin at 50 mg/L reduced the latent infection rate of muskmelons. Three and four sprays from anthesis significantly decreased latent infection rate and relative surface of fruit (Wang and Bi, unpublished data). Postharvest harpin treatment at 90 mg/L decreased decay severity caused by *A. alternata, F. semitectum* and *T. roseum* in Hami melons (Bi et al. 2007a). Similar results were observed by Ge et al. (2005a) in muskmelons inoculated by *F. semitectum* and *T. roseum.* A higher concentration over 90 mg/L failed to promote resistance and did not cause phytotoxicity to melons. Harpin did not demonstrate any fungicide effect *in vitro*, suppressed lesion diameter of fruit inoculated with *T. roseum* in treated and untreated halves of the same melon, indicating that the chemical induced local and systemic resistance. Besides, harpin provided greater level of

decay control in long-storage-life cultivars (cv. 8601) than in short-storage-life ones (cv. New Queen). The time between initial treatment with harpin and subsequent inoculation with *T. roseum* significantly affected efficacy of the induction (Bi et al. 2005). Harpin treatment applied at early stage of maturity was more effective than at later stage (Bi et al., unpublished data).

Studies have shown that harpin triggers a variety of cellular responses, such as activation of reactive oxygen species and cell membrane depolarization (Dong et al. 1999). Harpin induced a significant and progressively increasing activity of POD and CHT in muskmelon and Hami melons (Ge et al. 2005a; Bi et al. 2005; Wang et al. 2008). Postharvest application of harpin also increased activity of defense enzymes, and resulted in a production of activated oxygen species, an increase of the preformed antifungal compounds and total phenolics, and an accumulation of lignin, suberin and callose in epidermal cell of muskmelons (Bi, unpublished data).

3.5 Conclusions

Induced resistance may be an important part of postharvest disease control strategies of the melons in the future. Because of the apparent safety and the broad-spectrum nature of the induced resistance, research is underway to identify and develop elicitors that can be used to induce resistance in melons and thus make this resistance directly applicable to postharvest disease control. However, despite some studies as mentioned above, only a few cultivars have been studied in any detail. Having more concrete information on the biological spectrum of induced resistance on a cultivar-by-cultivar basis will be of use in determining which cultivar may be suitable for this type of control.

Having a better understanding of induced resistance response in more than one cultivar is important in developing any generalizations about this type of resistance. Information on the relative importance of putative defense mechanisms utilized in induced resistance is also limited. We know that induction of resistance is accompanied by the accumulation of PR proteins, defense enzymes and antifungal compounds, increasing of reactive oxygen and lignification of epidermal cells. There are other likely defense reactions and compounds that are also probably involved in the observed resistance. They could be more rapidly induced than the markers, and could be more effective against the pathogen (Hammerschmidt 1999). Each of the defense-related phenomena reported above have characteristics and correlations that strongly suggest that each is associated with the resistance state. However, the contribution of each to resistance appears to be small. This strongly suggests that the expression of full resistance requires the expression of several mechanisms, many of which are known to be coordinately regulated (Ward et al. 1991). Furthermore, understanding the defenses and the signals that regulate these defenses will also provide new avenues for implementation of induced resistance by genetic engineering or manipulation of signal pathway (Hammerschmidt and Becker 1997).

In our haste to realize the potential offered by induced resistance for postharvest disease control, we have paid too little attention to the factors that are likely to influence its effectiveness, largely using it inappropriately as simply a fungicide replacement. Therefore, there is an urgent need for understanding of the various factors (such as cultivars, maturity, timing of treatment, field environment, postharvest handling and storage condition) that will influence the expressing of induced resistance in melon fruit, in order to maximize the efficacy of resistance elicitors (Walters et al. 2005). A more realistic scenario to combat decay of harvested melons would be the use of integrated control approach combining biological and physical control strategies, with or without limited quantities of fungicides pre-harvest, and with efficient management and handling practices.

As the releasing of volatile compounds could be inhibited in ASM treated muskmelons (Jiang et al. 2007), there needs to evaluate quality change in melon fruit treated with elicitors and be assurance that induced natural defense compounds effective against pathogens are not present in consumed tissues at levels toxic to mammals (Paiva 2000; Dann 2003).

The implementation of induced resistance by chemicals in melons should be approached with cautious optimism. The enormous potential for reducing postharvest diseases via their natural disease resistance mechanisms has been demonstrated. However, more information is required to ensure that this type of resistance offers a safe, effective and reliable complement to the existing methods.

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References

Aharoni Y, Copel A, Davidson H, Barkai-Golan R (1992) Fungicide application in water and in wax for decay control in 'Galia' melons. NZ J Crop Hort Sci 20:177–170

Baker CJ, Orlandi EW, Mock NM (1993) Harpin, an elicitor of the hypersensitive response in tobacco caused by *Erwinia amylovora*, elicits active oxygen production in suspension cells. Plant Physiol 102:1341–1344

Barkai-Golan R (2001) Postharvest diseases of fruit and vegetables: development and control. Elsevier, Amsterdam, pp 27–32

Barkai-Golan R, Podova R, Ross I, Lapidot M, Copel A, Davidson H (1994) Influence of hot water dip and γ-irradiation on postharvest fungal decay of Galia melons. Postharvest News Inform 5:1136

Bautista-Banos S, DeLucca AJ, Wilson CL (2004) Evaluation of the antifungal activity of natural compounds to reduce postharvest blue mould of apples during storage. Mex J Phytopathol 22:362–369

Bi Y, Tian SP, Liu HX, Zhao J, Cao JK, Li YC, Zhang WY (2003) Effect of temperature on chilling injury, decay and quality of Hami melon during storage. Postharvest Biol Technol 29:229–232

Bi Y, Tian SP, Ge J, Zhao YH (2005) Harpin induces local and systemic resistance against *Trichothecium roseum* in harvested Hami melons. Postharvst Biol Technol 38:183–187

Bi Y, Tian SP, Guo YR, Ge YH, Qin GZ (2006a) Sodium silicate reduces postharvest decay on Hami melons: Induced resistance and fungistatic effects. Plant Dis 90:279–283

Bi Y, Ge YH, Li YC, Wang JJ, Mao XY, Li XW (2006b) Postharvest acibenzolar-S-methyl treatment suppress decay and induces resistance in Hami melon. Acta Hortic 1:393–399

Bi Y, Ge YH, Guo YR, Zhao J (2007a) Postharvest harpin treatment suppressed decay and induced the accumulation of defense-related enzymes in Hami melons. Acta Hortic 731:279–285

Bi Y, Ge YH, Wang CL, Li XW (2007b) Melon production in China. Acta Hortic 731:493–500

Bi Y, Li YC, Ge YH (2007c) Induced resistance in postharvest fruits and vegetables by chemicals and its mechanism. Stewart Postharvest Rev 6:11–18

Bokshi AI, Morris SC, Deverall BJ (2003) Effects of benzothiadiazole and acetylsalicylic acid on β-1, 3-glucanase activity and disease resistance in potato. Plant Pathol 52:22–27

Bokshi AI, Morris SC, McConchie R, Deverall BJ (2006) Pre-harvest application of INA. BABA or BTH to control postharvest storage diseases of melons by inducing systemic acquired resistance. J Hort Sci Biotechnol 81:700–706

Cao JK, Jiang WB (2006) Induction of resistance in Yali pear (*Pyrus bretschneideri* Rehd.) fruit against postharvest diseases by acibenzolar-S-methyl sprays on trees during fruit growth. Scientia Horticulturae 110:181–186

Cheah LH, Page BBC, Sheperd R (1997) Chitosan coating for inhibition of *Sclerotinia* rot of carrots. NZ J Crop Hort Sci 25:89–92

Cohen YR (2002) β-aminobutyric acid-induced resistance against plant pathogens. Plant Dis 86:448–457

Dann EK (2003) Induced resistance: potential for control of postharvest disease of horticultural crops. Proceedings of the Australasian Postharvest Horticulture Conference, Brisbane, Australia, October 1–3, pp 144–148

Dann EK, Zainuri (2008) Preharvest treatments for induction of resistance to postharvest disease in fruits. J Plant Pathol 90 (2, Supplement):S2.27 (abstract)

de Capdeville G, Beer SV, Watkins CB (2003) Pre- and postharvest harpin treatments of apples induce resistance to blue mold. Plant Dis 87:39–44

Deng JJ, Bi Y, Xie DF, Ge YH, Wang Y, Sun XJ, Li YH (2008) Effect of oxalic acid treatment on postharvest diseases and fruit quality of muskmelons. J Gansu Agri University 43:82–86 (in Chinese with English abstract)

Dong H, Delaney TP, Bauer DW, Beer SV (1999) Harpin induces disease resistance in Arabidopsis through the systemic acquired resistance pathway mediated by salicylic acid and the *NIM1* gene. Plant J 20:207–215

Du J, Gemma H, Iwahori S (1997) Effects of chitosan coating on the storage of peach, Japanese pear and kiwifruit. J Jpn Soc Hort Sci 66:15–22

El Ghaouth A (1994) Manipulation of defense systems with elicitors to control postharvest diseases. In: Wilson CL, Wisniewski ME (eds) Biological control of postharvest diseases-theory and practice. CRC, Boca Raton, pp 153–167

El Ghaouth A, Arul J, Wilson C, Benhamou N (1997) Biochemical and cytochemical aspects of the interactions of chitosan and *Botrytis cinerea* in bell pepper fruit. Postharvest Biol Technol 12:183–194

Exley C (1998) Silicon in life: a bioinorganic solution to bioorganic essentiality. J Biol Inorg Chem 69:139–144

Fallik E, Aharoni Y, Copel A, Rodov V, Tuvia-Alkalai S, Horev B, Yekutieli O, Wiseblum A, Regev R (2000) Reduction of postharvest losses of Galia melon by a short hot-water rinse. Plant Pathol 49:333–338

Fauteux F, Remus-Borel W, Menzies JG, Belanger RR (2005) Silicon and plant disease resistance against pathogenic fungi. FEMS Microbiol Lett 249:1–6

Friedrich L, Lawton K, Ruess W, Masner P (1996) A benzothiadiazole derivative induces systemic acquired resistance in tobacco. Plant J 10:61–70

Ge YH, Bi Y, Li M, Li X (2005a) Control of postharvest *Fusarium* rot and *Trichothecium* rot in harvested muskmelon (cv. Yindi) by Harpin. Agric Sci China 4:101–107

Ge YH, Bi Y, Ma LY (2005b) Study on the periods and ways of latent infection of fungus on muskmelon (*Cucumis melo* L. cv. Huanghemi) fruit. Watermelon Melon China 3:1–3 (in Chinese with English abstract)

Ge YH, Bi Y, Li X, Li Mei (2008) Induces resistance against Fusarium and pink rots by Acibenzolar-S-Methyl in harvested muskmelon (cv. Yindi). Agric Sci China 7:58–64

Gorlach J, Volrath S, Knauf-Beiter G, Hengy G, Beckhove U, Kogel KH, Oostendorp M, Staub T, Ward E, Kessmann H, Ryals J (1996) Benzothiadiazole, a novel class of inducers of systemic acquired resistance, activates expression and disease resistance in wheat. Plant Cell 8:629–643

Guo YR, Liu L, Zhao J, Bi Y (2007) Use of silicon oxide and sodium silicate for controlling *Trichothecium roseum* postharvest rot in Chinese cantaloupe (*Cucumis melo* L.). Int J Food Sci Technol 42:1012–1018

Hammerschmidt R (1999) Induced disease resistance: how do induced plants stop pathogens? Physiol Mol Plant Pathol 55:77–84

Hammerschmidt R, Becker JS (1997) Acquired resistance to disease in plants. Hort Rev 18:247–289

Huang Y, Deverall BJ, Tang WH, Wang W, Wu FW (2000) Foliar application of acibenzolar-S-methyl and protection of postharvest Rock melons and Hami melons from disease. Eur J Plant Pathol 106:651–656

Jakab G, Cottier V, Toquin V, Rigoli G, Zimmerli L, Metraux JP, Mauch-Mani B (2001) β-Aminobutyric acid-induced resistance in plants. Eur J Plant Pathol 107:29–37

Jiang YM, Li X, Bi Y, Zhou XP, Zhou W, Ge YH (2007) Inhibition of postharvest volatile compounds release by preharvest acibenzolar-S-methyl (BTH) treatment on muskmelons (cv. Yindi). Transactions of the CSAE 23:243–247 (in Chinese with English abstract)

Kessmann H, Staub T, Hofmann C, Maetzke T, Herzog J, Ward E, Uknes S, Ryals J (1994) Induction of systemic acquired resistance in plants by chemicals. Annu Rev Phytopathol 32:439–459

Klein JD, Lurie S (1991) Postharvest heat treatment and fruit quality. Postharvest News Inform 2:15–19

Kuc J (2001) Concepts and directions of induced systemic resistance in plants and its application. Eur J Plant Pathol 107:7–12

Liu HX, Jiang WB, Bi Y, Luo YB (2005) Postharvest BTH treatment induces resistance of peach (*Prunus persica* L. cv. Jiubao) fruit to infection by *Penicillium expansum* and enhances activity of fruit defense mechanisms. Postharvest Biol Technol 35:263–269

Liu J, Tian SP, Meng XH, Xu Y (2007) Effects of chitosan on control of postharvest diseases and physiological responses of tomato fruit. Postharvest Biol Technol 44:300–306

Lucas JA (1999) Plant immunisation: from myth to SAR. Pest Sci 55:193–196

Lurie S (1998) Postharvest heat treatments of horticultural crops. Hort Rev 22:91–121

Ma LY, Bi Y, Zhang ZK, Zhao L, An L, Ma KQ (2004) Control of pre- and postharvest main diseases on melon variety Yindi with preharvest azoxystrobin spraying. J Gansu Agric University 39:14–17 (in Chinese with English abstract)

Mayberry KS, Hartz TK (1992) Extension of muskmelon storage life through the use of hot water treatment and polyethylene wraps. HortScience 27:324–326

Meng XH, Li BQ, Liu J, Tian SP (2008) Physiologic responses and quality attributes of table grape fruit to chitosan preharvest spray and postharvest coating during storage. Food Chem 106:501–508

Morris S, Wade NL (1983) Control of postharvest diseases in cantaloupes by treatment with guazatine and benomyl. Plant Dis 67:792–792

Mucharroman E, Kuc J (1991) Oxalate and phosphate induce systemic induce resistance against disease caused by fungi, bacteria and viruses in cucumber. Crop Prot 10:261–265

Mullin P, Wang JS, Qiu D, Wei ZM (1998) Disease control and growth enhancement effects of harpin on tobacco. (Abstract) Phytopathology 88:S65

Paiva NL (2000) An introduction to the biosynthesis of chemical used in plant microbe communication. J Plant Growth Regul 19:131–143

Qin GZ, Tian SP (2005) Enhancement of biocontrol activity of *Cryptococcus laurentii* by silicon and the possible mechanisms involved. Phytopathology 95:69–75

Ryals JA, Neuenschwander UH, Willits MG, Molina A, Steiner HY, Hunt MD (1996) Systemic acquired resistance. Plant Cell 8:1809–1818

Schirra M, D'hallewin G, Ben-Yehoshua S, Fallic E (2000) Host-pathogen interactions modulated by heat treatment. Postharvest Biol Technol 21:71–85

Snowdon AL (1990) A color atlas of postharvest diseases and disorders of fruits and vegetables. Vol.1. General Introduction and fruits. Wolfe Sci. Ltd, Spain. pp 12–52

Spadaro D, Garibaldi A, Gullino ML (2004) Control of *Penicillium expansum* and *Botrytis cinerea* on apple combining a biocontrol agent with hot water dipping and acibenzolar-S-methyl, baking soda, or ethanol application. Postharvest Biol Technol 33:141–151

Spotts RA, Cervantes LA (1989) Evaluation of disinfestant-flotation salt-surfactant combinations on decay fungi of pear in a model dump tank. Phytopathology 79:121–126

Sykes S (1990) Melons: new varieties for new and existing markets. Agric Sci 3:32–35

Tally A, Oostendorp M, Lawton K, Staub T, Bassi B (2000) Commercial development of elicitors of induced resistance to pathogens. In: Agrawal AA, Tuzun S, Bent E (eds) Induced plant defenses against pathogens and herbivores. APS, St. Paul, MN, pp 357–369

Teitel DC, Aharoni Y, Barkai-Golan R (1989) The use of heat treatments to extend the shelf life of 'Galia' melons. J Hort Sci 64:367–372

Terry LA, Joyce DC (2000) Suppression of grey mould on strawberry fruit with the chemical plant activator acibenzolar. Pest Manage Sci 56:989–992

Terry LA, Joyce DC (2004) Elicitors of induced disease resistance in postharvest horticultural crops: a brief review. Postharvest Biol Technol 32:1–13

Tian SP, Qin GZ, Xu Y (2005) Synergistic effects of combining biocontrol agents with silicon against postharvest diseases of jujube fruit. J Food Prot 68(3):544–550

Uknes S, Mauch mani B, Moyer M, Potter S, Williams S, Dincher S, Chandler D, Slusarenko A, Ward E, Ryals J (1992) Acquired resistance in Arabidopsis. Plant Cell 4:645–656

Walters D, Walsh D, Newton A, Lyon G (2005) Induced resistance for plant disease control: maximizing the efficacy of resistance elicitors. Phytopathology 95:1368–1373

Wang JJ, Wang Y, Ge YH, Bi Y (2006) Inhibiting effect of postharvest Harpin treatment on Alternaria rot and induction to resistance enzymes of *Pyrus bretschneideri* Pingguoli. J Gansu Agric Univ 41:114–117 (in Chinese with English abstract)

Wang Y, Li X, Bi Y, Ge YH, Li YC, Xie F (2008) Postharvest ASM or Harpin treatment induce resistance of muskmelons against *Trichothecium roseum*. Agric Sci China 7:217–223

Ward ER, Uknes SJ, Williams SC, Dincher SS, Wiederhold DL, Alexander DC, Ahl-Goy P, Metraux JP, Ryals JA (1991) Coordinate gene activity in response to agents that induce systemic acquired resistance. Plant Cell 3:1085–1094

Wei ZM, Laby RJ, Zumoff CH, Bauer DW, He SY, Collmer A, Beer SV (1992) Harpin, elicitor of the hypersensitive response produced by the plant pathogen *Erwinia amylovora*. Science 257:85–88

Whangchai K, Saengnil K, Uthaibutra J (2006) Effect of ozone in combination with some organic acids on the control of postharvest decay and pericarp browning of longan fruit. Crop Prot 25:821–825

Willingham SL, Pegg KG, Langdon PWB, Cooke AW, Beasley D, Mclennan R (2002) Combination of strobilurin fungicides and acibenzolar (Bion) to reduce scab on passionfruit caused by *Cladosporium oxysporum*. Australas Plant Pathol 31:333–336

Wilson CL, El-Ghaouth A, Chalutz E, Droby S, Stevens C, Lu JY, Khan V, Arul J (1994) Potentatial of induced resistance to control postharvest diseases of fruits and vegetables. Plant Dis 78:837–844

Xie DF, Bi Y, Deng JJ, He SK, Lv SF (2008) Control of latent infection and post harvest main diseases with preharvest chitosan sprays in muskmelons. J Gansu Agric Univ 43:96–99 (in Chinese with English abstract)

Zhang D, Quantick PC (1998) Antifungal effects of chitosan coating on fresh strawberries and raspberries during storage. J Hort Sci Biotechnol 73:763–767

Zhang YM, An L, Bi Y, Liu JQ, Ma KQ (2005) Effect of heat treatment on the disease of Postharvest Muskmelon. J Gansu Agric Sci Technol 4:46–49 (in Chinese with English abstract)

Zhang ZK, Bi Y, Wang JJ, Wang Y, Zhang HY, Li WH (2006) Defense enzymes and disease resistance substances induction in muskmelons by preharvest BTH spraying. J Gansu Agric Univ 41:122–125 (in Chinese with English abstract)

Zheng X, Tian SP, Michael JG, Yue H, Li BQ (2007) Effects of exogenous oxalic acid on ripening and decay incidence in mango fruit during storage at room temperature. Postharvest Biol Technol 45:281–284